

CLAIMS

1. Apparatus for applying ultrasonic energy to tissue within the body of a living subject comprising:

(a) an ultrasonic emitter having an emitting surface generally in the form of a surface of revolution about a central axis;

(b) an inflatable lens, said lens having a refractive surface generally in the form of a surface of revolution about said central axis when said lens is in an inflated condition, said lens surrounding said emitter so that at least some ultrasonic energy emitted at said emitting surface will be directed through said refractive surface of said lens into the tissue of the subject.

2. Apparatus as claimed in claim 1, further comprising an elongated probe, said probe having a proximal end and a distal end adapted for insertion into the body of a living subject, said emitter and said inflatable lens being mounted to said probe adjacent the distal end thereto.

3. Apparatus as claimed in claim 2, wherein said inflatable lens is adapted to focus ultrasonic energy emitted by said emitter into an annular focal region surrounding said central axis.

4. Apparatus as claimed in claim 2, further comprising a bearing balloon surrounding said emitter and said lens, said bearing balloon having a bearing surface adapted to engage the wall of an organ of the subject.

5. Apparatus as claimed in claim 4, wherein said bearing balloon is operative to engage the interior surface of the wall of a tubular organ, so that said annular focal region lies along a ring-like path on said wall.

6. Apparatus as claimed in claim 5, wherein said bearing balloon is operative to engage the interior surface of a pulmonary vein.

7. Apparatus as claimed in claim 4, wherein said probe includes a first lumen communicating with said bearing balloon and a second lumen communicating with said inflatable lens so that said bearing balloon and said lens can be inflated with fluids having substantially similar acoustic impedances but different acoustic velocities, whereby the ultrasonic energy will be refracted at said refractive surface.

8. Apparatus as claimed in claim 2, further comprising a reflector structure including a first balloon defining an active region and a second balloon disposed adjacent said first balloon and contiguous with said first balloon over at least a part of said active region, so that said first and second balloons can be inflated with fluids having different acoustic impedances so as to form a reflective interface at said active region.

9. A method for applying ultrasonic energy to tissue surrounding a tubular internal organ of a living subject comprising:

(a) inserting an ultrasonic emitter having an emitting surface generally in the form of a surface of revolution about a central axis and an inflatable lens surrounding said emitter into the interior of said organ; and

(b) inflating said lens so as to bring said lens to a configuration having a refractive surface substantially in the form of a surface of revolution about said central axis; and

(c) actuating said emitter to emit ultrasonic energy so that said ultrasonic energy passes through said lens and is concentrated by said lens into a region having axial extent smaller than the axial extent of the emitter.

10. A method as claimed in claim 10, further comprising providing an additional refractive interface surrounding said lens so that the concentrated ultrasonic energy is refracted again at said additional refractive interface and propagates substantially radially from said additional refractive interface.